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Sanding, Singeing, Wetting and Steeping Cellulose Fabrics

By MYRON W. ALLING

Finishing Analysis

THE man who routes the various orders through a plant where dyeing and printing predominate must have a very broad experience with every operation in all of the departments for bleaching, dyeing, printing and finishing. He automatically becomes the analyzer of the customer's requirements for finishing the goods in question. It would be unusual to route a particular lot through every process in the mill, but it would not be unusual for the lots, as a whole, to require finishes which would call for these various operations and this accounts for the necessity of having an experienced man.

In most cases the customer includes on his invoice as many instructions as he is capable of giving, as well as a representative sample of the finish which he requires, but the detailed methods of accomplishing the result of each requirement he knows nothing about. Therefore, it is left almost entirely in the hands of the finishing plant to decide upon the methods for producing the proper finish and the result is designed to give the customer complete satisfaction in the work.

The necessary finishing analysis of a sample can usually be determined by the way it looks. Oftentimes the naked eye has to be assisted by the use of a microscope, depending mostly upon the weave of the cloth and the finish which it has been subjected to. It is inspected in accordance with the sequence of the operations through which the order passes. Therefore, the specimen is first placed horizontally on a level with the eye to see if there are any loose fibers sticking up. If there are, the routing schedule is marked, "no singe." If there are no loose fibers, the routing schedule is marked "singed." If the sample is bleached white or dyed on bleached cloth, it is marked "bleached." If it has loose fibers sticking up on one side and not on the other, it is marked "one-side singe." In case it has no loose fibers on either side it is marked "two-side single." If the sample happens to be a khaki twill or drill, and there are loose fibers sticking up, but it has a particularly clean face with practically no motes showing, it is marked "no single" and "sanded," providing the grey goods prove to be moty. In a similar manner the analysis of the sample is carried on, and all of the minute details carefully thought out, and the plan of operation completely checked on the routing schedule before the order is put into process.

Routing schedules form the basis of a very good system for keeping finishing records. Every variety of finish has a page of its own listed under each customer's name. The pages are placed in a key book which is kept in the office, principally for the guidance of the man in charge of routing, but it also provides a means of a permanent record of every order that comes into the mill worked out in all its details; not alone does it show the routing schedule, but spaces are provided for entering dyeing and starching formulae as well. In case of repeat orders the same sheet is used each time, but in such a case it is only necessary to enter their lot numbers in a column provided for that purpose.

Removal of Motes by Sanding

Singeing, sanding, and bleaching have a marked effect upon the appearance of the quality of a piece of goods. They are the foundation for transforming a rough, fuzzy, moty, and discolored piece of grey goods into a product that has the effect of appealing to the senses of sight and touch, so that its usefulness and beauty can readily be visualized by the purchaser and he or she, as the case may be, will look forward to having it as a part of their wardrobe, or as a decorative piece of material for beautifying their home.

It is strange, but nevertheless true, that one can be in the finishing business a great many years without ever having seen some types of finishing machinery. In fact, very few mills are equipped with a full line of textile machinery so that unless one constantly changes his position from one plant to another, he is bound to miss some of them. Take, for instance, my own case. I worked in six plants over a period of thirty years before I had seen a sanding machine. I suppose they are as old as the hills, but my first view of its effective operation for emerying off motes from grey goods was as interesting to me as my first mechanical toy.

Sanding enables one to have an almost instantaneous removal of motes and loose threads, reduces costs, shortens the scouring time previous to dyeing and gives an improved quality at the very beginning of productive operations. Some cloths are literally covered with motes and require a great deal of time, power, steam, labor, and chemicals to remove them by scouring on the jigs, whereas sanding removes practically all motes that are not too deeply embedded in the cloth in one operation.

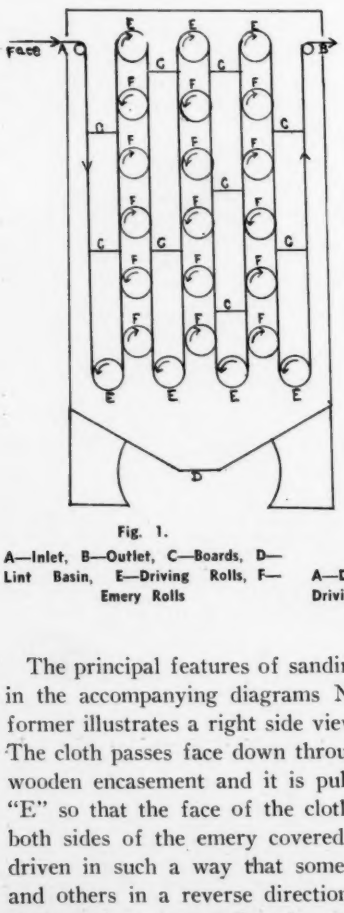

Fig. 1.
A—Inlet, B—Outlet, C—Boards, D—Lint Basin, E—Driving Rolls, F—Emery Rolls

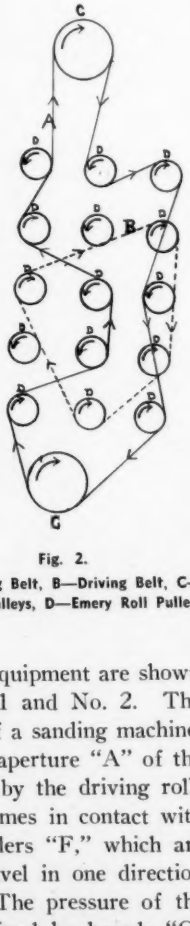

Fig. 2.
A—Driving Belt, B—Driving Belt, C—Driving Pulleys, D—Emery Roll Pulleys

The principal features of sanding equipment are shown in the accompanying diagrams No. 1 and No. 2. The former illustrates a right side view of a sanding machine. The cloth passes face down through aperture "A" of the wooden encasement and it is pulled by the driving rolls "E" so that the face of the cloth comes in contact with both sides of the emery covered rollers "F," which are driven in such a way that some travel in one direction and others in a reverse direction. The pressure of the cloth against these rollers is maintained by boards "C" which keep the cloth from whipping away from their points of contact. From the sanding rollers the cloth passes out of the aperture "B" directly through the singer, with or without the flame, according to whether the goods have to be singed or not. At the bottom of the sanding machine is a catch basin "D" for receiving the falling lint, motes, strings, etc.

The diagram No. 2 illustrates the driving apparatus on the left side of the machine. It is provided with two belts "A" and "B" which drive eight of the emery covered rollers "D" in the direction of the travel of the cloth and seven of them in the opposite direction. The cloth hits the emery rollers on both sides so that sixteen contacts are made in the first direction and fourteen in the second.

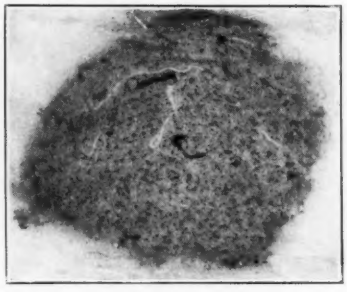

Fig. 3.

Figure No. 3 illustrates the mote filled lint that falls into basin "D" during the operation of sanding. The specks are motes and the strings are loose threads and knots, all of which were removed by the emery rollers.

Singeing

How else would one get the down off a chicken or the loose fibers, lint, filaments and fine hairs off the surface of cellulose fabrics except to singe them off? There are no new developments in this direction as yet, with the exception of the method of applying the heat with various types of apparatus, and with the fuels from which the heat is derived. A chicken can be singed over a burning newspaper, or it can be singed over a gas flame, the only difference is that one of these methods costs more than the other.

The normal cost of singeing varies in different plants according to local conditions. If the town, city, or bleachery is without facilities for furnishing gas, liquid Pyrofax or liquid Butane is used in a most convenient and economical manner from steel cylinders or tank cars under pressure. The liquid slowly changes to gas when the valve on the container is opened, and by thoroughly mixing air with the volatile matter produced from either of these heated fuels, complete combustion is obtained.

Many types of cloth and many types of finishes require singeing only on one side. The operation can be performed on both sides at once with an additional cost for material of approximately 20%. Pyrofax is more expensive than Butane, running as high as $250.00 for singeing 1,000,000 yards, as against $150.00 for singeing the same amount of goods with Butane.

Plate singeing has been superseded to quite an extent with rotary-roll singeing, and this in turn is being replaced somewhat by the newer type of perpendicular flame singer. See Figure No. 4.

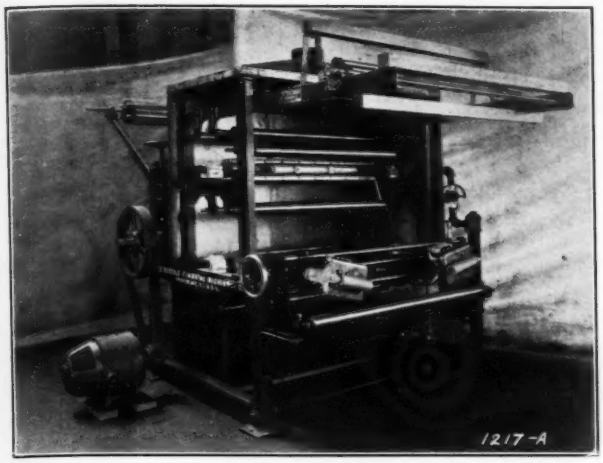

Fig. 4.

The roller machine with which I became the most familiar was equipped with a nickel chromium roll, guaranteed for 5,000 hours and costing $750.00 F.O.B. It lasted 1,510½ hours and had to be replaced on account of its unequal absorption of heat, due probably to oxidation of the metal. The method of heating the roll consisted of: (1) turning on the gas, (2) starting the air pump, (3) rotating the roll, (4) lighting the middle and the two end gas burners, (5) shutting off the two end burners when the temperature reached 1,400° F., (6) regulating the gas flow, and (7) regulating the air flow according to the weight of the goods to be singed, at which point the singeing began. To cool off the roller at the end of a day's run, the gas and air was turned off, the pump was kept running long enough to discharge all of the gas left in the pipe lines, the roller was kept running until its temperature reached 800° F. or below. This was necessary in order to prevent it from warping. It was then stopped, and when cooled to 400° F., it had to be polished with an emery disc in order to remove the scale of oxidation which had an insulating action that prevented the transfer of the heat to the surface of the cloth.

Wetting Out Grey Goods

Mills differ greatly in their methods of removing size from grey goods previous to kier boiling. The processes are usually adapted to the layout of the bleach house, to the mechanical apparatus in the bleach house, to the space alloted for bleaching purposes, and to the experience and ingenuity of the men in charge.

The initial process directly after singeing is common to all mills, as all singed cloth must be plunged immediately into live steam, or a solution of one kind or another in order to put out the sparks. Steam is used on material which has to be singed dry and subsequently scoured on the jiggs. All other bleached work is run through solutions of either water, rapidase, caustic soda, acid, or soap-like wetting out and detergent agents. Water is used where the regular procedure calls for steeping the cloth over night, either in steeping bins or in steeping kiers. Caustic soda, because of its more effective gelatinizing power, is used where it is necessary to shorten the steeping time. Rapidase, because of its quick converting power of starch is used where there is practically no provision made for steeping. Wetting out and detergent agents are used where kiers alone are used for steeping. Any one of these methods, in order to assure a uniform kier boil, must be thorough and uniform throughout the material in order to prevent the sizing from shifting around and becoming unevenly washed out.

Steeping

The purpose of steeping is to soften the sizing, swell or convert the starch, partly saponify the oils, waxes, etc., and yield a jelly that can be readily washed out or removed during the kier boiling. With water alone it takes about twelve hours. With rapidase it takes about three-quarters of an hour if properly regulated. The strength of the solution must be controlled, the time that it takes for the conversion of the starch must be determined, the solution must have a positive temperature control (160° F.) and the goods must be washed before any drying out takes place. With caustic soda a constant strength should be maintained, the temperature regulated (90° F.) and as it is much more effective in its gelatinizing power than water, the steeping time may be cut to from three to six hours. With wetting out and detergent agents, where the saturation of the cloth is accomplished in the mouthpiece of the automatic kier piler, the steeping time need not be longer than from three to six hours. After steeping, the goods should be throughly washed with hot or cold water and then kier-boiled.

Too much attention cannot be paid to the preliminary treatment of grey goods in order to produce effective and uniform results in kier-boiling. The complete removal or gelatinizing of starch is quite important as it allows the kier-boiling solution to act almost entirely upon the resistant natural impurities of the cloth instead of using up a good proportion of its strength upon the starch. The following experiments and discussion are designed to throw some light upon this subject:

No. 1—If one steeps 5 gms. grey goods (39" 80x80—4.00) for one hour at 140° F. in a beaker containing 100 c.c. water and 2.81 gms. Diastafor and then washes it thoroughly in cold water and dries it, there will be a loss in weight of 14.6%.

No. 2—By making the same experiment with the Diastafor left out, it will be found that the loss of weight amounts to 4.1% (easily soluble matter). By deduction, these two experiments would indicate that the specimen contained 10.5% of starchy matter.

No. 3—If we make another experiment with plain water, the same as in No. 2, with the exception that the temperature is increased to 212° F., it will be found that the loss of weight is increased to 11.2%, which includes the 4.1% and 7.1% of matter next in solubility and capable of being scoured out, which we will designate as starchy matter.

No. 4—In a last experiment with the same weight of grey goods, scoured at 180° F., for 1 hour in 100 c.c. water, 7 gms. caustic soda, and 1.873 gms. of a good penetrating and scouring agent, it will be found that the loss of weight amounts to 19.28%. This loss constitutes practically all of the sizing that a piece of grey goods of this construction contains.

In summing up the scouring power of the various substances, they may be subdivided as follows:

"A"—Water at 140° F. Removes	4.10%	easily soluble matter
"B"—Water at 212° F. Removes in addition.	7.10%	starchy matter Total—11.2% ("A" + "B")
"C"—Diastafor at 140° F. Removes in addition.	3.40%	starch Total starch—10.50% ("B" + "C") Total "A" + "B"+"C"= 14.60%
"D"—Caustic soda, and a penetrating and scouring agent at 180° F. Removes in addition.	4.68%	substances difficult of removal
	19.28%	total size
"D" alone removes.....	19.28%	size
"B" alone removes.....	11.20%	size
"C" alone removes.....	14.60%	size
"A" alone removes.....	4.10%	size

Let us look at these figures from a practical standpoint. Supposing a kier of goods (30,000 yds.), four yards to the pound, has to be bleached; our tests show that they contain 19.28% sizing, or 1,446 lbs. If we boil the cloth out with plain water before kier-boiling, 840 lbs. (11.2%) of sizing will be removed. If we diastafor the goods before kier-boiling 1,095 lbs. (14.6%) will be removed. If we simply wash them through a standard bleachery washer into the kier, approximately 307.5 lbs. (4.1%) will be removed. We have the option, therefore, of using the kier charge for acting upon and removing either 606 lbs. sizing, 351 lbs. sizing or 1,138.5 lbs. sizing. I presume, without having made the test, that steeping and washing would be about equivalent to "B."

In the above experiments it will be noted that boiling water removes 11.2% sizing. An addition of 7% caustic soda will allow it to remove 17.1% sizing, and a further addition of penetrating and scouring agents, according to their effectiveness, will allow a removal of sizing from below that of caustic alone, ranging from 16.6% to 19.28%, and when it comes to removing dirt, these same agents remove anywhere from 0% to 10%. A penetrating and scouring agent which does not have maximum detergent power, as well as maximum penetrating qualities for removing size which is most difficult to remove, fails in its effectiveness by 3.98%, which is almost as much as the 4.68% listed under "D" above.

(To be continued)

TECHNICAL NOTES FROM FOREIGN SOURCES

Machine Dyeing of Cotton on Cross-Spools

Karl Roland—Monats. f. Textil-Ind. 83, 47 (1932).—The above method of dyeing is warmly spoken of by the author, who does not definitely mention the principal advantage, that, as the yarn must be spooled at some time or other, it may as well be spooled, dyed, and passed along to loom or respooler, instead of its having to be laboriously dyed in the loose, non-compact, skein form, or in cops. For the proper carrying out of this method of dyeing, specially adapted machinery is, of course, best. First of all, the pump for circulation of the bath should be of a type having as few moving parts in contact as possible. Centrifugal pumps, being of the simplest possible construction, and capable of being coupled directly to the motor, are the best form. For the bath-chamber itself, it is, of course, so constructed, and in such dimensions, that the dyestuff, chemicals, steam, and water can be kept at the lowest optimum value. The dimensions of the pump, too, should be such that the bath can be pumped through the spools frequently; high capacity, rather than useless high pressure and low capacity, is the important factor. For ordinarily rather loosely (at least not tightly) wound spools, an open bath is sufficient; but for hard-wound spools it is rather better to employ vessels which can be closed steam-tight, and which will, if necessary, work under moderate pressure, which may be requisite for even, thorough dyeing.

When the first naphthol colors began to be used rather widely, the Zittauer Machine Works brought out a small, continuous dyeing apparatus for cylindrical or conical cross-spool dyeing. The apparatus is still doing good service here and there. The main principle involved was simply that of forcing the dye-liquor through the wound mass from within outward, then from the outside inward, then drawing or forcing out the retained liquor, followed by removal of the spools from the spindles (hollow) (the latter standing upon a main hollow shaft, through which the bath was drawn and forced alternately, through the hollow spindles). A single worker could take care of 800 cylindrical or 400 conical spools in one hour.

The newer types of machine, however, are so constructed that all the related processes, wetting-out, boiling out, the dyeing itself, rinsing, oxidizing, draining, soaping, and washing, can be carried out in the same apparatus. But wetting-out can also be carried out in a separate, simple apparatus, when continuous working seems necessary, the special apparatus being reserved for the actual dyeing. The subsequent processes can also be carried out in simpler, non-special forms of apparatus.

The wish has been expressed that the new apparatus might be used for bleaching as well as for dyeing. This in most cases is impossible, since the apparatus is constructed of iron. However, in cases where cast iron is used, some workers do employ the apparatus successfully

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Uses of Glue and Gelatine

In the Textile Industries*

By A. H. PETTINGER, B.Sc., A.I.C.

THE international association known as "Epidos," whose headquarters are at Glaris, Switzerland, has announced that prizes to the value of 20,000 Swiss francs are to be awarded for the discovery of new uses for bone glue. This offer is open to people of all nationalities, irrespective also of trade or profession, and the condition of award is that the thesis must represent original work and indicate some new avenue of utility for this product. For this country the competition is in the hands of British Glues and Chemicals Limited, London. Glue and gelatine in one form or another are both already extensively employed in many industries for sizing or as an adhesive, but such known uses will not gain points; it is something entirely new that is wanted. In view of the interest which this competition is bound to arouse, it may be worth while to reconsider some of the lesser known modes of using glue and gelatine in the textile industry.

As an assistant in the scouring process, glue has been recommended once or twice. The firm of Bayer in 1914 claimed (G.P. 294,028) that such additions to the usual soap and soda liquor prevented lime soaps flocculating. Any success in this direction may be put down to the colloidal nature of glue solution.

Then Rinoldi (1920) described experiments wherein he added 2—3 parts of glue to 1—2 parts of soap and thereby diminished the destructive effect of the alkali resulting in 5% less loss of wool, and obtained a yarn with a better handle.

It is also used to some extent in dyeing, including silk. Where boiled-off liquor is not available, glue solution may be substituted and exerts a similar protective action. Rinoldi asserts that its addition aids the penetration and levelling of acid and mordant dyes. Faded garments which are to be redyed are said to be improved by a preliminary soaking in glue of 4 to 5% strength.

According to Holden (J. Soc. Dyers and Col., 1928) the treatment of certain fibers with gelatine or bone glue brings about an increased affinity for dyes. Wool, silk, rayon or cotton is impregnated with a 5 to 20% solution of gelatine and then steamed under pressure of 5 lb. per sq. in., whereby the gelatine is rendered partially insoluble, due probably to anhydride formation. The increase in affinity for dyes is in direct proportion to the amount of gelatine fixed. The resulting shades have improved fastness to washing. Details are also given for preparing cotton with gelatine prior to mordanting with tannin and the material can then be dyed with basic colors and deeper shades are produced. (E.P. 313,980 and 328,831).

A claim has been made for treating vegetable fibers which have been dyed with ice colors with emulsions containing sulfonated oil, gelatine and a chlorinated hydrocarbon such as carbon tetrachloride (F.P. 592,452, 1926). In this case the gelatine only functions in the capacity of an emulsifier and so is merely of second importance.

The emulsifying property of glue and gelatine is also made use of in a patent (U.S.P. 1931, 1,769,850) covering the de-lustering of viscose rayon by an emulsion containing wax, soap, glue and an abrasive material. The same property applied in another sphere of industry, namely, rubber, causes gelatine to be added to the latex to stabilize it during concentration. According to Traube, latex so stabilized separates into two layers, the upper one containing nearly all the rubber. Gelatine is used again to obtain "synthetic" latex; a process which aims at turning waste and reclaimed rubber into an emulsion in water.

In connection with all processes which employ gelatine for wetting and emulsifying, it should be noted that a low surface tension is subject to certain conditions of acidity. Peard and Johnson found that at the iso-electric point (pH 4.7) the surface tension of gelatine was distinctly greater than under any other conditions.

Several patents have appeared wherein glue and gelatine are used in finishing and printing to get fancy effects. Scheurer (Bull. Soc. Ind. Mulhouse 1925, 91, 469) prints fabrics with metallic powders to obtain imitation gold and uses as ginding agent gelatin which has been heated under pressure, presumably to render it insoluble. Clarke and Browne (E.P. 247,757) incorporate glue into a resist

*The Textile Manufacturer.

paste containing also gum arabic and sodium fluoride and they claim that this mixture is easily removed again after printing. Fancy pattern effects on cotton and cellulose acetate silk union materials are produced by using glue as a reserve and dissolving the non-reserved part out with acetone or pyridin. (E.P. 237,909).

Scott and Thomson (E.P. 251,102) obtain permanent linen effects by printing a resist of gelatine on a cotton fabric and afterwards giving it a treatment with sulfuric acid so that the non-resisted parts are parchmentized.

A few claims employ the principle of rendering gelatine insoluble by treatment with formaldehyde. Brylinski (1926) impregnates cotton with a mixture containing a solution of 10% gelatine, 3% formaldehyde (40%) and 2—4% turkey red oil. He claims that the liquor remains fluid for 1½ hours, but later coagulates to a compound insoluble in water (when heated to 40° C.)

A certain number of patents for waterproofing depend upon this reaction. Behr & Co., Inc., and F. J. Crespi (E.P. 211,203, 1924) treat paper on the back with solutions of glue and formaldehyde used successively and after drying make it flexible by a further treatment with boiled linseed oil dissolved in benzene.

While the treatment of boiler scale is not essentially a textile problem, it is none the less one which men in that industry are frequently called upon to deal. Sauer and Fischler (Z. angew Chem. 1927, 40, 1176) state that precipitation of scale is largely prevented by colloidal matter, among the substances cited, gelatine is mentioned. The regular addition to the boiler feed of such material is stated to reduce the dangers associated with hard lime scale.

TECHNICAL NOTES

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for bleaching; especially where the yarn is to be dyed subsequently to tones not of a tender, delicate sort. If such tones are to be produced, there is no escape from the use of special wooden apparatus with hard-lead fittings.

In general, the new forms of apparatus are distinguished from each other by the kind of carrier employed for the spool. Some employ spindles and forms, others forms without spindles, others spindles without forms. Each system, as usual, has advantages and the contrary. Perhaps most favor has been shown to the systems which involve a hollow spindle and a form or core.

In this case, what is called the core is a tube, mostly perforated with many small holes, upon which core is wound the yarn; the wound spools are packed one upon another, upon the spindle, and the liquor is drawn or forced through the perforated tube formed by the successive sections, the cores, upon which the yarn is wound. Machines carrying as many as a thousand cylindrical spools at one loading are manufactured. These cores are made of Nickelin, non-rusting steel, or well-impregnated fiber or cardboard. In case non-impregnated cores are used, they cannot be piled up one over the other upon the spindles, as they will soften and crush by their own weight, in the hot liquor. In this case, the spindle or carrying-shaft or tube must lie horizontally, the spools being slipped upon short, projecting, lateral continuations of the central carrying tube.

Where no spindles are employed, the spools are placed one above another, packed regularly upon a properly perforated false bottom, so that, as before, the liquor can be pumped up through the hollow center of the pile, and through the winding. The separate columns of spools are more or less separated, and kept in place, by movable partitions, mostly of porcelain. The topmost spools are covered by a removable pressure-plate or diaphragm, of sufficient weight to hold the cores and cones well together, and to keep the liquor from merely running out of the top of the channels, without being forced through the spooled yarn.

When a substantial core is not used as the basis of the spool, the wound yarn is built up upon a core of woven fabric, tubular, slipped upon the spindle, winding—so that, when the spool is wound, the hollow core is kept in shape (i.e., does not collapse inward) merely by this permeable fabric-core, which, of course, permits much freer circulation of the liquor.

Most of any of these forms of apparatus are provided with means for forcing compressed air through the dyed spools in the assembled condition, to blow out the spent liquor as far as possible, and, in the case of some dyestuffs, to oxidize the dyeings.

Synthetic and New Waxes

Dr. G. Friederichs—Farben-Chemiker 413, 3 (1932).—Many of the natural waxes and allied substances have been in wide use, for various purposes, in the textile industry, for many years. With the increasing use of some of them, of late years, and the possibility of allied forms or derivatives, either not existent naturally or difficult to isolate from natural sources, much attention has been paid to the possibility of producing such substances, even the naturally occurring ones, synthetically from more easily available natural sources. As an example of one direction in which such researches have been carried out, the group of high-molecular simple (mono-acid) alcohols may be mentioned.

The lower alcohols, methyl, ethyl, propyl, butyl, and amyl alcohols, have been useful in textile work for a long time, either directly as such, or in the form of derivatives. The higher members of the series, from C_6 onward, have not been much regarded, not because they possess no valuable properties, but merely because no simple process for their preparation, at a reasonable cost, has been known.

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Historical Survey of Dyestuffs and Dyeing

By B. C. BOND

OUR earliest records of man's life go far back to a different geological age from our own. Here, on the threshold of history we find evidences of man using pigments to stain his body, to color skins he wore, and probably to dye or stain many other objects as well, while there still remain to be seen his paintings of bison, horses and reindeer portrayed in bright colors on the walls of the caves of Altamira.

The pigments he used were yellow, red and brown, together with black and white, and the lavish use of color appeared to play an important part in his burial ceremonies. It is even supposed, according to H. G. Wells, in his "Outline of History," that at this early age, twenty thousand years ago, primitive man actually made use of a crude printing process in order to produce designs on the skins with which he clothed himself, using an engraved or pointed bone cylinder for this purpose.

Painted pebbles belonging to men of the Azolian age, seventeen thousand years ago, have been found, but the meaning of these stones daubed with stripes, dots and "E" shaped markings remain a mystery.

Some ten to twelve thousand years ago we find that Neolithic man had commenced to weave a rough cloth made of flax which was in all probability dyed or stained. In this age not only was weaving first introduced, but also the art of the potter, which again calls for the use of color. When, however, we study the history of the earliest tribes of which we have any historical account, we find amongst the people inhabiting the Valley of the Nile and of the Euphrates some five to six thousand years ago evidences of a civilization already far advanced which knew and practiced spinning, weaving, dyeing of fabrics, and produced thereby colored material of considerable variety.

We see, therefore, this desire for color extending back as far as our earliest knowledge of mankind, and the use man made of it was only restricted by the means at his disposal. As new substances for coloring were discovered so the practice of dyeing, staining and painting increased until at the present time, with the wealth of colors at our disposal, we find that almost every object, whether of personal adornment, of decoration, or of utility is colored, and in consequence the dyeing and coloring of textile fibers plays no unimportant part in the social life of the community.

A brief review of the historical progress of dyeing shows us that in the time of the ancient Egyptians the art of dyeing was extensively carried on with a variety of different natural coloring matters, many of which had probably been known for thousands of years already. Mummy cloths from the tombs showed that they were mainly dyed with these vegetable and mineral colors, indigenous to the countries, such as Safflower, yielding a pink, replaced today by the Rhodamines and Eosines. Iron Buff was used, and is now, forty-five hundred years later, as a fast shade. Recent discovery of the tomb of Tutankhamen, showed material dyed with Indigo, which must have reached Egypt from India where the Indigo plant occurs naturally.

Later still, about two thousand years B.C., we find the Egyptians, according to Pliny, considerably advanced in their methods of dyeing, and with a working knowledge of the use of mordants. Pliny states, according to Thomson, that "There exists in Egypt a wonderful method of dyeing. White cloth is stained in various places, not with dyestuffs, but with substances which have the property of absorbing colors; these applications are not visible upon the cloth, but when they are dipped into a hot caldron of the dye they are withdrawn an instant after dyed. The remarkable circumstance is that though there be one dye in the vat, yet different colors appear upon the cloth; nor can the color be afterwards removed."

The famous purple dye which made Tyre renowned throughout the civilized world is also of considerable antiquity. Thus Plutarch, in his life of Alexander, describes how in the palaces of the Persian King was found a large quantity of purple dyed material, which, although one hundred and eighty years old, had retained its brilliancy. Again, Virgil, in the Aeneid, dealing with Dido, the Tyrian princess, mentioned in Book I—

"For Tyrian virgin bows and quivvers bear, the Purple buskins o'er their ankles wear."

Also, "Now purple hangings clothe the palace walls,

And sumptuous feasts are made in splendid halls;
On Tyrian carpets, richly wrought, they dine."

This color, the dyeings of which commanded a fabulous price, was obtained from a species of shell fish inhabiting the Mediterranean. Friedlander, dissected no fewer than twelve thousand (12,000) of these molluscs to obtain less than 1½ grams of the coloring principle, which, on analysis, he showed to be di-brom Indigo, allied to some of our recently discovered dyestuffs. It is remarkable that Indigo and Tyrian purple in use thousands of years before the Christian era, are vat dyes, the application of which is one of the most difficult of dyeing operations at the present time.

Dyed fabrics are often mentioned in the Bible, in Ezekiel: "The images of Chaldeans portrayed with Vermillion—with dyed turbans"; and again in Exodus: "Rams' skins dyed red"—the red referred to being probably Kermes, an insect found on oak leaves, from which is obtained a dye capable of being applied on a mordant.

These dyestuffs gradually spread to the western world, and were known to the Greeks and Romans who, in addition, made use of the lac dye which, like Kermes, is obtained from an insect which came from India. Various plant extracts were in use, Weld, for instance, being a favorite color for dyeing the garments of women, and for the robes of the Vestal Virgin. During the Dark Ages after the fall of Rome, the art of dyeing in common with the other arts and sciences of the Old World, fell into a period of decay.

A considerable revival of dyeing took place with the Renaissance, when in that period of universal growth of trade and learning dyers' guilds were formed. The first guild of this description appears to have been one formed in Germany in the 12th century, a similar guild being formed in England about the same time, to which a charter was granted by Henry IV, in the fifteenth century. At this period we find that the dyestuffs generally used in England and Germany were the natural vegetable products, such as wood, plant grown in India, Lichen, Weld, Galls cultivated or found locally, while Kermes and Madder, which were also used, must have been imported. During the Elizabethan period the English explored the farthest borders of the New World and returned with many new coloring matters, most important being Indigo, Cochineal and Logwood. Later we find other natural materials, such as Safflower, Cudbear, Peachwood, Barwood, Quercitron Bark, and Fustic, while the cultivation of Madder was commenced in England during the seventeenth century. Natural Indigo was the coloring matter obtained from the plant Indigo Fera, or Woad grown in India. It is planted in February, and by the middle of June is 3 to 5 feet high, ¼ inch diameter stem. It is harvested very much like grain. The leaf, the chief factor of coloring matter, is a yellowish green color, and contains on an average ½% pure coloring matter by weight. It is steeped in a series of vats nine (9) to fourteen (14) hours at 30° to 35° C., and fluid drained; beaten by wheel spokes in other vats until matured. Logwood or Campeachy wood is the product of a large tree known botanically as Haematoxylon Campeachianna, which grows in the West Indies and several states in South America. The finest wood was formerly imported from Capeachy, hence the name. When the trees are first felled, the wood is colorless, but in the course of a very short time it takes to a dark brownish red color. The coloring principle was first investigated by Chevreul in 1810.

Haematoxylon is the result of the decomposition of a glucoside which exists in the fresh wood, and is the real coloring matter. In order to bring about this decomposition, the wood is chipped and after addition of water, placed in heaps. The heaps are turned frequently in order to allow the air to act on the Haematoxylon. This operation is called "ageing" or "maturing" Logwood. Haematoxylon is then converted into Haematin by oxygen of the air. The best Logwood yields only about 3% coloring matter by weight. It has always been used extensively in dyeing of all textile fibers and all classes of fabrics, by use of various fixing agents, such as sumac, chrome, etc. This gives one an idea of the long process they had to go through to obtain coloring matter in previous ages.

A new age was inaugurated in 1856, by Perkins, and since numberless coloring matters have been derived from coal tar by synthetic process. He was endeavoring to prepare quinine from Allyltoluidine by oxidation with potassium bichromate, but obtained a red powder instead. This experiment, on being repeated with Aniline, resulted in the production of a black substance which on boiling with alcohol, gave a violet colored compound—Mauve, the first synthetic dyestuff within a generation.

Most of the natural dyestuffs became obsolete when the Synthetic or Coal Tar dyestuffs were adopted.

The new born dyestuff industry was at first well established in England, although a considerable number of colors were also being made in France. The British industry, however, lasted sixteen years, when competition from Germany became so severe that it shrunk comparatively in small proportions, and did not again become of importance until the war. In 1862, Nicholson discovered the water soluble blues, the first of the synthetic acid dyestuffs, and in 1864, Griess discovered the action of nitrous acid on primary amines, and showed that the diazotized compound would couple with other amines, thus paving the way for the Azo colors.

The Azo dyestuffs have given us the majority of these two important classes, Direct Cotton Colors and Acid Colors.

The first important member of the Azo class to be marketed was Chrysoidine, discovered by Witt and Caro in 1876, this being followed by other yellows and thereby Fast Red in 1877, afterwards followed one by one in rapid succession. Only four years later the Alizarines were synthesized by Caro, Graebe and Lebermann.

(Continued on page 503)

PROCEEDINGS OF THE
American Association of Textile Chemists and Colorists

AUGUST 14, 1933

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The Value of Research*

By **ROBERT E. ROSE**

President, American Association of Textile Chemists and Colorists

I HAVE chosen to speak to you on the value of research. That we may have before us a clear idea of the subject, it is well to consider the meaning of the human activity described by the word "research." Research is the working method of science by which facts are observed and described and then used as the basis for generalizations or laws, the validities of which are scrutinized by attempting an experimental proof on the basis of the law.

This sounds more complicated than it is, although it is more difficult in practice than it seems.

As an example of the difference between the mere collection of information and its practical use and the scientific method we call "research" I can cite no clearer case than the advance made in our knowledge of the laws of heredity. Ever since man became an agriculturist, he has been very much interested in heredity. By attention to the results of crossing his animals he slowly came to know a great deal about this difficult subject. Even in the hieroglyphs carved five thousand years ago by the Egyptians, we see, beyond any doubt, that cattle breeding had been carried far enough to produce a good

*This paper was presented by Dr. Rose at a special meeting of the South Central Section on May 26th. The meeting was held at the University of Chattanooga in Chattanooga. It was open to the public and a large attendance resulted. Dr. Rose was introduced by President Alex Guerry of the University.

beef steer, unlike any wild animal. In horticulture it was not so easy to control breeding but merely by selecting the seed of plants having characteristics a little more to his liking than the average man transformed his cereals so completely as to make them unlike any natural grasses. Now in all of this the method was simply an observation of facts and a selection of the best strains from the point of view of the farmer. There was no effort to explain the variations observed. This is the simple fact-finding method of acquiring knowledge; it does not lend itself to the formulation of laws.

In 1866, a monk, who later became the abbot of his monastery, was seized by a desire to understand something of the laws of heredity. He was instinctively scientific and in consequence did more with a few rows of pea vines than all the farmers in all the world had done before him. Mendel, this monk, set himself the problem of determining exactly what happens when two strains of peas, each breeding true, are crossed. He crossed the blossoms artificially and then he planted all the ripened peas produced by the crossed blossoms. He examined the vines which grew for certain characteristics which were readily observed—height, smooth or wrinkled pod, smooth or wrinkled seed, color of dried seed, etc. He soon found that the results of the cross were just as definite and just as easy to predict as the days in the month. Some of the qualities were dominant, that is, in a cross all the offspring resembled one parent but the next generation divided quite regularly into a certain number showing the dominant feature and a certain number showing the recessive feature. The latter would breed true, the former still varied in the next generation.

The laws that Mendel established are just as true of human beings as of plants and we can state quite surely the chance of cleft palate, or black eyes or of albinism or of bleeding in the children of parents whose ancestry is known.

Therefore, this simple research has been of inestimable value to the human race and the results of it are the basis of all animal and plant breeding experiments. It was a typical research, attention could be focused on one characteristic at a time, the number of experiments allowed of averaging the results and eliminating mere chance and work was done in order to reach an understanding, not to make a product more useful.

It is a strange fact that practically every fundamental advance in the useful application of research rests upon work that was done because of scientific curiosity without thought of any other end than gaining a truer understanding of things as they are. This is perhaps the characteristic of research most difficult to understand. Actually it is not too much to say that the chance of research producing useful results is directly proportional to its apparent distance from practical applications, paradoxical as this may sound. This statement is true provided the research is properly carried out.

Research then is the inductive method used in learning more of the behavior of all that is the universe about us. It began to affect human thought when the Middle Ages with their religious philosophy, their concentration on the paramount importance of the world-to-be and their contempt of the material world passed into that period known as the Renaissance with its emphasis on the philosophy of life, of beauty, of art and of things material. It is true that the philosophers (not the artists) during the early years of the revival of learning lived in a rigid atmosphere of belief in the ultimate truth of the classics, yet it was not long before Galileo let the small and large ball fall from the tower of Pisa and showed that both hit the ground together, proving that Aristotle was wrong and thus establishing a road to the inductive or experimental method of research.

It took three hundred years before the new method began to be valuable in a practical as well as in a philosophical way. When it did, the change in man's relation to his environment became more and more startling until at present our whole civilization is built upon the results of research.

Let me point out in greater detail why this is true. Research deals with all the aspects of the universe and, to use the classical definition, all that we know objectively can be placed in two categories, matter or energy. This definition suits my purpose even though the present view is that there is no difference that is fundamental between the two, all that we know being but manifestations of energy.

The value of research lies in its giving human beings greater control over their environment, that is, over matter or energy, to the end that we may lead easier, healthier, and happier lives.

The control of mechanical energy was of such obvious value that the differentiation of the human animal as man came into being as an accompaniment of the addition of tools and weapons to the mere use of faculties and limbs. A stone axe increases the speed of man's hand and the spear increases the distance at which a human being can be effective. The bow and arrow and the sling were the results of early research on the utilization of mechanical energy. The lever marked a great forward stride. It was used in the dim dawn of mankind but the principle of its efficiency was not clear until the time of Archimedes. In carrying loads, in doing work, such mechanical additions to man's muscles are limited by the fact that the energy used is merely that of geared up muscle.

However, tools did a great deal to advance civilization We have but to think of the plough, the loom, the spinning wheel, the potters' wheel and the traps, snares and nets of hunters and fishermen. All of this advance was based on a kind of primitive objective research. But

man realized that in nature there were forces much greater than any tool could give his arm. He saw the torrent carry rocks before it and he saw the wind bend great trees and the first machines he made were water wheels and windmills. These saved him from the great drudgery of grinding corn by substituting the force of great masses of molecules in motion for muscle.

Toward the end of the Middle Ages man made his first successful attempt to use the energy of a comparatively small number of molecules set in very violent motion by chemical change; he invented gun powder and found a most alluring new kind of machine that could drive a stone much faster and farther than could a sling and that could break down strong walls.

Next came the harnessing of the force of molecules made to move by heat. The kettle lid is raised when the water in the kettle boils because the water molecules hit the lid so hard. Watt and Stephenson by building a machine used these flying molecules to make the steam engine, a great advance over the water wheel because it made power mobile.

Notice that in this series the force used is moving faster: Man's hand, running water, the wind, molecules driven at frantic speeds. But there was another form of energy so terrible in its devastating violence that primitive man regarded it as the very weapon of his god, the flash and roar of the thunderbolt. That genius of research, Benjamin Franklin, was the first to dare to bring the lightning to earth, an experiment that came near ending his career. It was the less spectacular work of Volta into the reason for the twitching of frogs' legs when connected with a voltaic pile that began the conquest of the last form of energy.

Michael Faraday was the genius who first used the research method in investigating electricity as a form of energy. It was he who first found that an electric current flowing through a conductor produced an electro-magnetic field, and it was he who performed that experiment which was to mark a new era in the utilization of the result of research for the advancement of mankind. I can think of no better moment upon which to dwell in my effort to make clearer to you what research really means than that when Faraday, for the love of knowing, tried to prove by experiment that a movable conductor would move in a magnetic field if a current flowed through it. Think of that man in his simple little laboratory with his simplest of apparatus assembled by his own hands, watching that piece of wire, as it moved when the current from a voltaic pile was put to work. At that moment the first of all electric motors was created and the energy of electrons became man's tool. I think it might be well if we thought of Faraday, the gentle philosopher of colossal intellect, as the emancipator of millions from toil, as a discoverer who added not only a new continent but a whole new world to the possessions of mankind. He conquered for mankind a region of untold riches and he did it in peace, harming no one. That is research at its finest, the most valuable of all human activities, constructive in every way. Beside his achievement the record of the generals of all mankind seems less imposing and much less important than most human beings seem to think.

Electricity is the motion of electrons and these travel with the velocity of light. It is this feature of electrical energy that gives us what no other form of energy can do, power to act instantly at a distance. We speak over the telephone to remote parts of the world and the words reach our hearer's ears as quickly as though he were beside us and his answer comes back as fast. The symphony concert comes to us through the air and we hear it with the audience within the hall. Every industrial plant and every home is evidence of the unique powers that electricity as a tool in the hands of research physicists and engineers has added to our lives.

Let us come to the story of the incandescent lamp as an illustration of the fact that the spirit of research is not dead, and that Faraday's example is still being followed. Irving Langmuir, the last Nobel prize winner in chemistry, when he began his work became fascinated by the wonders of the realm of atoms and molecules. He was, however, not willing to study the behavior of these particles in ordinary chemical reactions—he wanted to study them individually—where could he find such simplicity, when billions of molecules occupy a space too small to see? Research looks in the most unlikely places for its materials and Langmuir looked into a vacuum—a place as nearly nothing as anything on earth and this he had available in the old Tungsten electric light bulb. In this nothing of the Tungsten lamp he could "see" what happened to a few molecules and atoms left there as of no consequence. He found that water settled on a Tungsten wire in a layer one molecule deep and he was able to discover how heat is lost from an incandescent wire.

In consequence of this he was able to invent the nitrogen filled lamp which we use today, which gives us more light and yet saves the country something like $200,000,000 a year, and the atomic hydrogen process of welding, besides contributing to the fundamental knowledge necessary for the development of the radio tube.

Some time ago I saw a demonstration of an electrical slave in charge of an isolated electrical power substation. If you wanted to know whether all was well you had but to call his number on the telephone, ask him and he would inform you. If you wanted him to shut off part of the current or to turn on the lights or to open the windows, all you had to do was to whistle the right note into the 'phone and hang up. In a few moments this robot called you back to the 'phone and signalled that he had done your bidding and all was well. If anything went wrong at his end he called and called for three minutes and then hung up, if you did not answer him. He'd done his best. This

mechanical man in the substation was no more than a series of radio tubes and amplifiers, products of research.

It is impossible to give even an outline of all that the conquest of energy has meant to us and even now research is pushing on. The control of matter growing out of research is just as significant. Mere observation of facts gave primitive man copper and tin and produced the bronze age of early civilization; iron and steel clothed the knights of the age of Chivalry. Chemistry, when it became a science in the past 75 years, gave us aluminum, molybdenum, tungsten, vanadium, sodium, magnesium, chromium, nickel as new metals, chlorine, bromine, iodine, as non metals, but these elementary bodies, invaluable as they are, became lost in the vast mass of new substances that go to our industrial progress. There is no object that we use today that has not been influenced by the new kinds of matter that man has made. The produce of the fields is made better by fertilizers and protected from insects and disease by artificial products. Food supplies are kept in cold storage plants, using synthetic ammonia; or, put into cans made of tin plate and protected by a special lacquer on the inside of the can. Cotton, wool and silk are all processed by using artificial kinds of matter unknown to nature, such as soap, lye, bleaching powder and dyestuffs, and rayon is entirely artificial. Every piece of metal equipment we use, all our paints, all our plastics are new materials. Naturally I am most familiar with products of my own company. After the war the first really important product we made was Duco and since its discovery illustrates how research may lead to entirely unexpected results I shall tell you about it. We were making photographic movie films using a celluloid base; this base is very inflammable and as it runs through a machine it becomes highly charged with static electricity. Sparks then cause fires. Grounding this machine did not cure the evil and we decided to do some research. Obviously if we could make the film a conductor, it would lose its static charge, therefore, the director of the laboratory decided to try adding salts to the dope from which the gas was made. Salts were not very soluble in this and the best way was to try a great many. After the salts were added the laboratory was closed for the night. Next day the man in charge of the work brought a test tube to the director and told him that it was very curious that the dope in this tube was quite fluid, in all the others it was as thick as usual. To this one tube he had added sodium acetate. The experiment was repeated with the same result. A thin nitrocellulose dope as a base for a lacquer was ideal and it was perfected as *Duco*.

The making of new films for lacquers naturally lead to research in making new vehicles for paints, and in this direction the permanence of the new synthetic films manufactured by the du Pont Company is so much greater than that of the old linseed oil paints that now the difficulty is to find pigments that will last as long as the paint. In addition to their permanence, these new vehicles dry much faster, although they spread as easily and, therefore, they reduce the cost of application.

Cellophane was invented by a Belgian during the war. We formed a company to handle the product in this country and soon began improving it. Cellophane is rayon in sheets. It is really like a sheet of cotton without any air between the minute fibers so that it is transparent. There seems no end to the uses of this product. Perhaps you do not know that hot-dogs are made with a Cellophane skin—each day 400 miles of them.

Very profound research made it possible for us to discover a new kind of substance as tough and elastic as rubber and vulcanizing readily, but unlike rubber not much affected by oil or gasoline. This material which we call Duprene is so much longer lived than rubber when in contact with oil that it lasts 10,000 times as long. Naturally it can be sold for a very much higher price. Our present trouble is that our small pioneer plant is not able to supply the demand. It may interest you to know that Duprene is made from lime, coke and water—no living thing has any part in its synthesis other than the men who control the operation. It contains only carbon, hydrogen and chlorine. But it can only worry you to carry this list further, and I prefer to point out what research has done for us.

There is no more important matter than that of health. It is only a generation since research proved that the great scourges of mankind were in some cases the result of the invasion of the body by bacteria. Since then typhoid, cholera, diphtheria, yellow fever, malaria have all ceased to be of any importance in civilized countries with the proper health protection. The conquest of diphtheria is typical of the value of research. First came the recognition of the real nature of the white membrane that choked out the lives of more children in a year in this country alone than would be measured by all those that fell in all the terrible battles fought around this city (Chattanooga). Then came the discovery that the blood of those who had had the disease was altered and it was for that reason that the disease did not strike the same child twice; then came the experiment to see whether the material causing the protection could not be made by giving an animal diphtheria; or, at least inoculating it with bacteria. Man's friend, the horse, was found to be suitable and the serum from his blood, properly purified to safeguard against infection has saved millions of children. You have no conception of the work that has been necessary to bring about this result which has since been pushed further by the use of a preventative inoculation—the Schick treatment. As I pass by a schoolhouse and see the children pour out, as I see the policeman protecting the street crossings for them, I always think of the invisible band of research men, who stand between those

children and the ghastly death that used to kill 50 or 100 in every thousand.

Let me use the case of that very hopeless disease, pernicious anemia, to illustrate again the minute care with which research proceeds. Animal experiments showed that there was something in liver which kept rats alive when the rest of the diet was insufficient. Then it was found the ash of liver did just as well. Remember that anemia was supposed to have been an iron deficiency. Liver ash contained iron, but giving the rats iron did not save them. Then it was found that liver ash contained traces of copper and adding this saved the rats. Now we know that copper is just as essential as iron in keeping us alive and by using it we can keep pernicious anemia in check. The hospital is full of other examples of the value of research. Painless surgery by using ether or a local anesthetic, carried out on patients whose skin has been sterilized with iodine or alcohol is a triumph of research. And research is giving us a mastery over our own bodies; the diabetic can live a long life because insulin offsets the failure of his pancreas. The dwarfed child can be made to grow to normal size by the use of the hormone of the pituitary gland. Some children who would be idiots can be made normal by making good, artificially, the failure of their bodies.

As for our industrial life, it is simply bewildering to try to think out how much it depends on research; not only do we make all kinds of new things but we make them incredibly fast.

I have just been through some of the industrial plants of the South. I have seen some three thousand looms in one room making cloth at least twenty times as fast as the fastest hand-loom. Those machines were doing work that would have required twenty thousand weavers and they were tended by about two hundred. I have seen mills using 1,500 bales of cotton a week. I have seen miles of woven cotton apparently moving by itself through a mill, being singed, bleached, stretched, dried, folded and packed. I have seen one mill able to make one million towels each working day. In the home of the "Camel" I have seen a machine making enough cigarettes in a minute to keep one smoker busy for two days without stopping to eat or sleep and lighting one cigarette from another. I have seen marvelous machines making full fashioned hosiery, one dozen pairs each forty minutes with a precision and a beauty beyond that of any human hand. All of this amazing production, which gives to man-made things the overwhelming volume of natural phenomena, like flowing rivers and falling rain, is possible only because of what engineering research has given us.

Man has no senses other than have the higher animals; some of his senses are indeed less highly developed than those of a dog; his sense of touch is much finer. But research has added to his ability to see, to hear, and to touch to such an extent that he has outdistanced all other living things immeasurably. The universe about him was bounded by the fixed stars visible to his eye; he has increased the power of his vision until he can see universes 100,000,000 light years away (remember the sun is only 9 light minutes distant). Small things he can see even to one 10,000th of an inch; he can watch the track made by the electron, a particle 1,800 of which would weigh only as much as one atom of hydrogen, 600 thousand million million million million of which weigh as much as a tenth part of a drop of water. With his ears he can hear around the world or listen to the crash of the disintegrating radium atom, while it is being used for curing diseases. His arm he has strengthened until he can fashion great plates of steel into battleships, lift tons as though they were but grains of sand, and drive himself through space at hundreds of miles an hour. His fingers he has made to pull apart the molecules; thus from clay he has taken the atoms that go to make aluminum pots and pans. He has learned to fit atom to atom until he has made indigo better than nature's and in addition other dyes, drugs and chemicals all unknown to mother nature herself. All of this means that in a material way man has made his life infinitely richer and that he has made his experience far more complex.

Science has not shown us the marvels of the world merely as the circus shows us human freaks. It has given us a new eyesight that we may look upon beauty. I do not mean that we can go into the mountains or down to the sea more easily than we could and feast our eyes upon lovely scenery. I mean that the hills can tell us the beautiful story of their birth in the waters of the sea, of their growth into high peaks all capped with snow, and thheir age-long molding my water, air, and frost until they are now your friendly, lovely green mountains. And the trees can mean much more to you if you can read the story of their coming from the tree ferns and mosses and mare's tails of the world when coal was made. You can give to your children no richer heritage than to see all the universe, from even the little living things in the drop of stagnant water to the distant stars, through the eyes of science. Thus you will give them the vision of beauty, to see which is their right.

But research has given us this better knowledge not only of Nature. The beauty of man's creation is made available to you and yours. Of all man's works, music is the supreme art; it transcends all matter or words in expressing the loftiest of all that the spirit can utter. Research has done for music what Gutenberg first did for letters. Take all these new riches, give them to your children, and one day mankind will find that life is full of beauty, full of joy, and that the material riches that research has brought to us, which we think of as the most valuable achievement of science, are the least of what it has given us, for research is but the search for truth, and truth is beauty, and by truth shall we be saved.

Proceedings of the American Association of Textile Chemists and Colorists

The Adler Planetarium in Chicago

THE visitor to the World's Fair should not confine all his attention to the exhibits specially erected for the exposition. The Adler Planetarium is one of Chicago's most valued permanent possessions. Most people have heard that it is the only one in America, but just what it is and what it does is less definite in their minds. Standing on an island in Lake Michigan to the East of the Field Museum and the Shedd Aquarium it forms with those a trinity dedicated to the study of "The Heavens above, the Earth beneath, and the waters under the Earth." It is the only one of the three within the enclosure of the Fair gates, and this because its geographic position placed it within them naturally. Admission is 25 cents and includes the Astronomical Museum and a seat at the lecture given hourly on the hour.

Within the Dome of the Adler Planetarium in Chicago, Dr. Fox starts his lecture. The skyline of Chicago painted around the base gives the feeling of being out-of-doors, and when the lights are turned off and the stars come out on the dome, the illusion is complete.

The founder and donor of the Planetarium is Mr. Max Adler of Chicago and its purpose, as expressed in his presentation address, is to enlarge the popular conception of the Universe and through the dramatization made possible by the Planetarium instrument to dwell upon the truth, too infrequently considered, that the world and all human endeavors within it are governed by established order.

The building is a regular dodecagon in shape and is constructed of rainbow granite with a copper dome. In the center is the Planetarium chamber and dome and here is the instrument, marvellously intricate, which dares to bring the heavens indoors. After years of experimental work at Jena this great optical apparatus was developed to create the illusion of the mysterious silent march of the worlds of Nature. It is done by having the great sphere fixed, its inner surface serving as the projection screen as the instrument throws upon the fixed hemisphere the little images of the heavenly bodies and thus represents the Stars in position and in motion just as we are accustomed to see them in the natural clear sky. No more versatile instrument was ever invented for exhibiting the phenomena of a given science. As Dr. Fox says in the catalogue its success is convincing, even inspiring.

The optical Planetarium is a composite stereopticon with many projectors throwing images on the interior surface. It can show the naked-eye stars, the Sun, Moon, and planets, all in their proper places for any instant of any year of any century for any terrestrial position. Just to think of the optical technique, the mechanical skill, and the astronomical knowledge necessary to bring this marvelous illusion before you is staggering. The calculation necessary to represent 9,000 stars is completely overwhelming to those who sit spell-bound watching the presentation.

To describe it properly one would have to be as learned and as interesting as the Director, Dr. Fox. One can only say that from that moment when, sitting in blacky darkness, you suddenly see the stars burst forth above you, bringing a gasp from your throat and tears to your eyes, so terrific is the emotional reaction, until the moment when you see the sun rising and hear the lecturer wishing you Good Morning! You have forgotten Time, the World's Fair, Chicago, and best of all, yourself.

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Proceedings of the American Association of Textile Chemists and Colorists

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary any vacancies which may occur in their businesses.—A. Newton Graves, Secretary, care Franklin Process Company, Providence, R. I.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive

NOTE. Persons who have obtained employment should notify the secretary at once. Prospective employers may file vacancies either with the secretary or the AMERICAN DYESTUFF REPORTER.

A-1

Education—Ph.B., Brown Univ. '27, P.G. at N. C. State (M.S. this June).

Experience—several years experience as an analytical and research chemist; private research work on sulfonated oils. Twenty-seven years old, married. Will supply references.

A-2

Education—B.T.C., Lowell Textile Institute, 1932; also course in shorthand and typing.

Experience—None to date, interested in quantitative analysis, experimental dyeing, color matching, dye testing and dye identification. Ability to learn quickly and will go anywhere. 23 years old, single.

A-4

Education—Sc.B.Chem., Boston University, 1929. Short course at Mass. Inst. Tech. on microscopy and textile testing.

Experience—Employed in print works of mill, to May 1931,—laboratory work on chemical analysis, dye testing, trouble shooting and development work. To January 1933 was employed by textile specialty manufacturer doing analysis and product duplication, and also plant control and development work.

A-B-1

Experience—over twenty years' experience in the laboratories of various chemical manufacturers, four months' experience as second hand in dye house, familiar with all types of dyes and fibers. Thirty-nine years old. Will supply references.

A-B-2

Education—Lowell Evening Textile School, 1917.

Experience—Five years' experience in hosiery dyeing, full fashioned hosiery of silk and cotton and silk, also men's hosiery containing rayon, wool, cotton and celanese. Several years experience in laboratory work. Has also had experience in jig-dyeing of cotton piece goods, slub and top dyeing.

A-B-E-1

Education—B.S. in chemistry at C.C.N.Y. Working now on M.A. at Columbia.

Experience—7 years as dye tester and color matcher for dye manufacturer; 6 months skein silk and rayon dyer; 4 years textile chemist and dyer for cotton finishing concern; 2 months boss bleacher and 4 years as teacher of organic chemistry and dyeing. Age 38, single.

A-E-1

Education—Ph.D., Univ. of Illinois, studied chemical engineering at Columbia, licensed chemical engineer, New Jersey.

Experience—10 years' experience teaching in colleges, subjects included chemical and textile subjects. Has had broad experience in industrial work including experience in testing materials, research and consulting. Will go anywhere; references.

A-E-2

Education—B.T.C., Lowell Textile Institute, 1933.

Experience—Assistant instructor in chemistry, Lowell Textile Institute. Member of scholastic honorary fraternity.

B-1

Education—educated and trained in chemistry and calico printing in Glasgow, Scotland.

Experience—Has been with large print works as colorist for 13 years producing first class work on cotton, rayon, wool and silk fabrics. References.

B-2

Experience—Boss dyer with one firm for 18 years, divisional supt. at print works for 1 year, in charge of processing and dyeing of cottons and rayons at large bleachery for 6 years. Prefers bleachery in East but will go anywhere. References.

B-3

Experience—Foreman piece dyer for the past 21 years. Can dye the following; celanese, rayon, cotton backs, wool, silk and mixed fabrics. Has knowledge of finishing and laboratory work.

B-6

Education—Graduate R. I. School of Design.

Experience—5 years in bleachery, 7½ years as assistant dyer, 2 years as boss dyer and 3 years as superintendent of dyeing and finishing. Married, 33 years old. References.

B-7

Experience—4 years as assistant to manager in ribbon mill; 2 years as boss dyer on veils, chiffons and silk skeins; 5 years as boss dyer on ribbons and skeins (cotton and silk); 7 years as boss dyer on spun silk (pure dye and fast) resisted colors; last 12 years as hosiery dyer on silk and cotton, silk-cotton, rayon or wool. 50 years old, married. References.

D-1

Education—Graduate textile course, 1911, Georgia School of Tech.

Experience—Has had experience in all branches of the textile industry but chiefly in sales work. Was at one time in the dyestuff business and later in hosiery manufacturing. Prefers Middle Atlantic or southern states.

F-1

Education—Textile Institute, Alexander Hamilton Inst., Extension work at Brown Univ., working knowledge of German.

Experience—Has had executive departmental work with all types of textiles manufacturers. Acquainted with all types of textile machinery, dyestuff application, laboratory practice, cost methods, and checking methods and processes. References.

B-D-F-1

Experience—Has held positions as general superintendent of a print and dye works and a finishing company; held a position as boss dyer in a bleachery for 6½ years and as a colorist on 11 printing machines for 3½ years; has held a position as boss dyer for 6½ years with a finishing company and received general training for 3½ years; and has also been dyer in a mill dyehouse. Desires position as superintendent, colorist, dyer or salesman and solicitor.

AMERICAN
DYESTUFF
REPORTER

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A BILLION TO BANKS

IN A recent radio address by Jesse H. Jones, chairman of the Reconstruction Finance Corporation a plan was disclosed whereby the administration offered to add $1,000,000,000 to the capital reserves of banking institutions as a means of replenishing the stream of commercial credit and thus enlisting the aid of these institutions in the national recovery program. It was proposed through the R.F.C. to buy up to $50,000,000 of preferred stock in any sound institution. The plan has the approval of the President and inasmuch as the plan can be carried out without added tax burden and without cost to the public treasury it will add no hardship to the lot of the citizen.

It is believed by the administration that further improvement in business conditions with increased expansion and higher prices will require more support in the way of credit than is now available. This plan of supplying banks with capital would enable the banks to supply the credit without endangering their own position or that of their depositors.

Mr. Jones said in part: "Any bank, that has functioned as a bank should function, has taken losses and accumulated some slow and frozen assets, and this without the slightest criticism of the bank management. To absorb the losses most of the banks have reduced their surplus and reserve accounts and some of their capital stock.

"The government is now willing further to repair these losses and in effect to carry the slow assets by the purchase of preferred stock in sound banks on a very favorable basis.

"A billion dollars or even a half-billion dollars of added capital to the banks of the country can be multiplied many times in the extension of credit.

"Ample bank capital will not only strengthen the banks and make it possible for them to respond to the credit needs of the country but it will strengthen the morale of the bankers, and both are necessary if we are to conduct our banks in harmony with the recovery program."

He further stated that the policy of forced liquidation should cease "and borrowers not only given time to work out their own problems, but encouraged to take an active part in the recovery program.

"No one blames a banker for wanting to be able to pay his depositors upon demand, and I am not finding fault but merely calling attention to the fact that, if banks are to be run on such a liquid basis as to be able to pay their depositors on demand, there will be no credit for business —and that simply stops the works."

This nation is urgently in need of increased credit and if the above plan works as well as is hinted it will be a boon to American industry.

THE ANNUAL CONVENTION

AN UNUSUAL condition presents itself this year in regard to the Annual Convention of the American Association of Textile Chemists and Colorists, in that it has been separated into two distinct parts. The Convention will be held in Chicago on September 8th and 9th and the meeting proper for the election of officers, etc., will be held in New York in December. The reason for this is that it was desired to hold the convention in Chicago during the time while the Century of Progress Exposition would still be in existence and so the date of the Convention was brought forward to September.

We have brought to the attention of the readers for the past several months the advantages to be gained and sights to be seen at the World's Fair. It must not be forgotten however that the advantages of attending the Convention of the A. A. T. C. & C. are also worthy of consideration. There will be the usual excellent program of technical papers and worthwhile discussions. The opportunities for the informal exchange of theories and practical viewpoints are also beneficial. It is a place where one may meet men who speak his own language.

We urge all members of this association to make their plans now to attend the Convention. It is doubly worthwhile this year with the Century of Progress as an added attraction.

Decision on Intermediates

A decision of importance to the coal tar industry was rendered recently by the U. S. Court of Customs and Patents Appeals in the case of Charles Hardy, (Inc.) vs. United States Piperidine, the particular product involved in the case, is classified for duty at 7c per pound and 40% ad valorem under Paragraph 27 (a) (3) of the 1930 Tariff Act. The result of this decision is that it establishes definitely the classification of imported intermediates not mentioned by name in Paragraph 27.

The contention of the importer was that the *similarity* mentioned in 27 (a) (3) was the same *competitive similarity* provision as used in appraisal under Paragraph 27 (d), which is the accomplishment by the imported article of substantially the same results when used in the same manner as the domestic product. However this contention of the importer was not upheld by the court. If it had been only the products mentioned by name in Paragraph 27 could have been included and appraised in that classification and all others when imported would fall into the classification under Paragraph 5 at 25% ad valorem.

"A Century of Progress Colors"

The dramatic role that color has played in America's artistic and industrial advancement in the past one hundred years is vividly expressed in the brochure, "A Century of Progress Colors," just issued by the Textile Color Card Association. In this colorful brochure are reproduced the brilliant hues appearing on the exteriors of all principal buildings of A Century of Progress International Exposition, now being held in Chicago.

These vibrant, pulsating colors, in perfect tune with the unusual form of architecture and the dynamic spirit of the Exposition, include vivid blues, radiant orange and yellow tones, daring reds, lively green and scintillating gold and aluminum, relieved by black and white. The entire picture thus affords a gorgeous panorama of color by day and night.

This rich "palette" of twenty-two shades remains a glowing tribute to the artistic genius of the late Joseph Urban, who, as Director of Exterior Color and Decorative Effects of the Exposition, conceived this daring color scheme and directed its completion from New York, as illness prevented him from being in Chicago.

A key to the colors used on the various buildings also appears in the brochure. The imposing Hall of Science, for example, presents a dazzling color spectacle in rich blue and orange hues, with a dash of red and white. The Travel and Transport Building, a unique achievement, is enlivened by brilliant yellow, blues and green. Color is thus utilized in a new way to impart life and vigor to architectural form.

The plan of presenting "A Century of Progress Colors" to American industry is that of Margaret Hayden Rorke, managing director of the Textile Color Card Association. For over a year, Mrs. Rorke has conferred with the officials of the Exposition at Chicago and procured their authorization to portray in brochure form the colors used on the exteriors of the buildings.

"It is by these hues," Mrs. Rorke explained, "that the Exposition has expressed so dramatically the spirit of progress and the vital part that color has played in our modern industrial life. These animated colors, reflecting the tempo of a new age, will offer a timely inspiration to all branches of art and industry."

Special mention is made in the brochure of the following officials of A Century of Progress International Exposition for their generous assistance and cooperation: Rufus C. Dawes, president; Lenox R. Lohr, general manager; Dr. Allen D. Albert, assistant to the president; Joseph Urban, director of exterior color and decorative effects, his associate, I. L. Scott, and his assistant, Otto Teegen; Louis Skidmore, chief of design, and Shepard Vogelgesang, supervisor of color and decorative effects, of the Exhibits Department.

Resigns Research Post

Following the resignation of Harry E. Kaiser as director of the Hercules Experiment Station, the Hercules Powder Company has announced the appointment of O. A. Pickett as acting director, effective August 15.

Mr. Kaiser, whose resignation was accepted with regret by Hercules officials, is returning to California where his presence is necessitated by business and family interests. He has been connected with Hercules research work since 1918 and has been director of the Experiment Station since 1922. In 1931 the Station was transferred from Kenvil, N. J. to elaborate new laboratories near Wilmington, Delaware, in the design of which Mr. Kaiser had an active part. He is a graduate of the University of California.

O. A. Pickett for a number of years has been in charge of the Experiment Station Physical Chemistry Division.

Purchases E. C. Klipstein

The Calco Chemical Company, Incorporated, of Bound Brook, New Jersey, has purchased the plant and business of E. C. Klipstein and Sons Co. of South Charleston, West Virginia, whom they have heretofore represented in the sale of their dyestuffs. The Klipstein company has been producing sulfur black since 1916 and has been active in the development of the synthetic anthraquinone process.

Historical Survey of Dyestuffs and Dyeing

(Continued from page 492)

The next discovery of notable importance was that of the first sulfur color, "Cachou de Laval," prepared in 1873 by Croissant and Brettoniere, by simply heating organic refuse with sulfur. It was 20 years later before the first satisfactory sulfur color, Vidal Black, was made. The importance of these colors was immediately recognized, and many of these colors were soon patented. Congo Red, discovered in 1884, by Boettiger, was the first of the direct cotton colors. Numbers soon followed afterwards.

In 1880, R. Holliday took out patents for the production of insoluble Azo dyestuffs on the fiber, an important development of Griess' discovery, and one which has received an impetus in recent years by the introduction of the New Naphthols. Another extension of the Diazo reaction was due to A. G. Green, who, in addition to the isolation of Primuline, in 1887, also drew attention a year later, to the fact that this color could be diazotized on the fiber and developed with various amines and phenols.

The most important discovery of the twentieth century has undoubtedly been that of the vat colors. At the close of the nineteenth century, in 1884, synthetic Indigo was put on the market by the Badische-Anilin-und Soda Fabrik Co. in Germany, and was immediately successful. Seven years later, in 1910, Indanthrene, the first of the Anthraquinone vat dyes was discovered by R. Bohn and many members of the same class followed. In 1904 the Algol vat dyes were introduced and in the next year the first of the Indigoid dyestuff, namely, Thio-Indigo Red B, made its appearance, followed by Ciba colors in 1906, the Helindone in 1908, and a rival to Indigo, Hydron Blue, in 1909.

Deviation of Coal Tar Colors

Before we go into the discussion of each group of colors, I will give a rough description of the derivation of these synthetic or coal tar colors.

The dry distillation of coal is carried out on a large scale in the manufacture of illuminating gas and coal gas. Coal gas or illuminating gas passes first through a series of pipes or condensers, and in doing so leaves a deposit of gas tar or coal tar together with the gas liquor. The coal tar and gas liquor separate into two layers. The upper one or gas liquor contains ammonium carbonate, ammonium sulfide and other compounds. From the liquor most of the ammonia and ammonia salts were obtained until new processes of manufacturing nitrogen compounds from atmospheric nitrogen were discovered. The bottom layer in the tank is coal tar. It is a mixture of a great many organic substances. For many years it was useless as a by-product. It is now the source of a great many substances of much importance. In order to partially separate the tar into its constituents, it is submitted to fractional distillation. In this way the tar is roughly separated into the following fractions:

(a) Light oil collected up to 170° C.
(b) Middle oil between 170° and 230° C.
(c) Heavy or Creosote Oil between 230° and 270° C.
(d) Anthracene Oil above 270° C.

The first fraction is a product which has a specific gravity of 0.975, hence the name light oil. This oil is first redistilled and fractions collected in three portions, these portions being obtained at temperatures from 82° to 110° and 110° to 140° and 140° to 170° C. These fractions contain impurities which are both acid and basic nature. They are, therefore, treated separately first with conc. sulfuric acid, which removes basic substances, and then with caustic soda, which removes acid substances. The products are then redistilled and from the first they obtain 90% benzol, which is equivalent to 7% benzine, and obtain 50% benzol, which is equivalent to 4% to 5% benzine.

(b) From the crude fraction or middle oil naphthalene is obtained.
(c) From the heavy oil carbolic acid is obtained.
(d) From the anthracene oil anthracene is obtained which is used in the manufacture of the alizarine dyes.

We obtain aniline oil from taking benzene as a starting point and treat with nitric and sulfuric acid, so-called mixed acids; nitro-benzene is formed which is then treated with a mixture of iron filings and hydrochloric acid, and obtain aniline oil. Aniline is a base or intermediate used extensively in a large number of coal tar colors. These colors may be classified as follows:

(1) Basic colors.
(2) Phthalic Anhydric colors.

(3) Acid colors.
(4) Direct cotton colors.
(5) Sulfur colors.
(6) Mordant colors.
(7) Mordant acid colors.
(8) Insoluble Azo or Ingrain colors.
(9) Reduction vat colors.
(10) Aniline black.
(11) Acetyl cellulose colors.

Basic Colors

1. The Basic Colors were the first so-called "Artificial" colors from coal tar discovered by Perkins. They are derived from ammonia by replacement of one or more hydrogen atoms of one or more molecules of ammonia with various other elements or groups of elements. These substituted ammonias, like ammonia, are basic in character, and like all bases, have the power of neutralizing acids. It is for this reason this class is designated as the Basic Colors.

The Basic Colors combine readily with silk and wool without aid of any mordants, producing very brilliant shades. They do not have any direct affinity for cotton. However, by mordanting cotton in a bath made up of 5% Tannic Acid based on weight of the goods, at a boil for ½ hour, then allowing the cotton to steep over night in this tannic acid bath, next morning giving a light squeeze and passing into a fixing bath of 3% antimony tartrate (tartar emetic) for ½ hour cold, rinsing thoroughly. This is called mordanting the cotton with tannin mordant having fixed insoluble antimony tannate on the fiber. The Basic Colors will readily combine with this mordant, thus coloring the cotton. Basic Colors are not fast to light, washing, soaping or perspiration. They are characterized for their brilliancy of shades. They are used for topping off of other dyes in order to brighten up the shade, and it is necessary to use only a small amount for topping as they possess very high tinctorial power.

Basic Colors find their use in dyeing leather, paper, and various textile fibers where brilliancy of shade without fastness is wanted. When dyed on wool, silk, and leather are generally faster than on cotton.

Colors of this class are dissolved with equal quantities of 30% acetic acid as color and dyed on cotton at 140° to 160° F. On wool and silk at 180° F.

Phthalic Anhydride Colors

2. The Phthalic Anhydride Colors include a few dyestuffs such as Eosines, Rhodamines, Fluorescein, Erthrosines, etc. They are so called for they are derived from Phthalic Anhydride. They find their chief use in the dyeing of silk and wool for bright shades, such as evening gown materials, etc. They are limited to a certain extent in cotton dyeing. They are dyed similarly to Basic Colors on cotton.

Acid Colors

3. Acid Colors are so called for two reasons, first, because they are without exception acid in character, and second, because they dye wool so readily in acid bath. The Acid Colors are of great importance in silk and wool dyeing. There are three classes of Acid Colors:

(a) Those that are nitro compounds, that is, those containing the nitro group, and are prepared by action of nitric acid upon certain organic compounds. There are but few members of this class, and all of them produce yellow to orange shades, such as Picric Acid and Naphthol Yellows, for example.

(b) The Sulfonated Basic Colors, that is, those which are prepared by the action of conc. sulfuric acid upon various basic colors. During this action the characteristic properties of the basic dyestuffs are lost and converted into acid dyestuff producing similar shades. Their coloring power is reduced, yet their fastness properties are correspondingly increased.

(c) Those that are Azo compounds, that is, those containing one or more azo group structure (—N=N—). The dyestuff of this division are by far the most numerous and valuable of the acid colors. Acid Colors are dissolved in boiling water and dyed on silk and wool from an acid bath, either with acetic acid or sulfuric acid. Silk requires either 3 to 5% soap or some of its "boiled-off liquor" in addition. The acid dyes do not have any affinity for cotton. They vary in fastness properties, and careful selection must be made to meet the necessary requirements in dyeing fibers with these colors.

Direct Cotton Colors

4. Direct Cotton Colors were the first colors to dye cotton directly without aid of any mordant, and for this reason they were named direct cotton colors. Congo Red was the first discovered by Boettiger in 1884, and today we have a vast range of this group of colors. They are soluble in boiling water and dye cotton, viscose or any vegetable fiber with the addition of common salt. The degree of concentration of the dye-bath is an important factor in dyeing of cotton with this class of colors, for the more concentrated the dye-bath the more easily the coloring matter is absorbed by the fiber.

It is impossible to characterize all direct cotton colors as having the same properties, though they belong to the same class and all dye in approximately the same manner; each color has its individuality. For instance, Direct Sky Blue 6B, very fugitive to light, while Direct Fast Blue 2R is equivalent to a vat blue in fastness to light. The direct colors are not considered as being fast to washing, but some of these colors can be made to possess good fastness after dyeing, by after-treatment with chrome, copper sulfate, formaldehyde, etc. There is a demand today for even faster colors than the ordinary direct cotton colors after-treated; for perspiration, hot

pressing, sponging, dry cleaning, etc. A class or subdivision of the direct cotton colors called diazo or developed colors, are employed to meet these requirements. They are dyed directly on the fiber, but after dyeing have the property of being diazotized with sodium nitrite and hydrochloric acid in an ice cold bath, washed well and entered into developing bath containing suitable developer for the shade required. Various developers, for example, beta naphthol, meta-toluylene-diamine, beta-oxy-naphthoic acid, pyrazolon, etc.

Each developer produces a distinct shade, for instance: cotton or viscose fiber dyed with Direct Blue BHD when developed with beta naphthol yields a navy blue; when developed with meta-toluylene-diamine yields a deep black; when developed with beta-oxy-naphthoic acid yields a purple.

Direct and Developed Colors are used largely in printing of vegetable fibers. Most all colors of this class have little affinity for the new acetate rayons such as celanese, acele, seraceta, rhodiaseta, chacelon, sombraceta. By proper choice of direct or developed cotton colors and acetyl-cellulose rayon colors one can either produce a solid shade or two-toned shades on a cotton-acetate rayon, or viscose-acetate rayon fabric by the one-bath method. As high as from five to six color effects can be produced on the properly constructed fabric.

Sulfur Colors

5. Sulfur colors are so called for three reasons:
   a. Sulfur is a constituent of all dyes.
   b. Sulfur and sodium sulfide are both used in their manufacture.
   c. Sodium sulfide is a necessary constituent of the dye bath.

The Sulfur Colors are used mostly for dyeing of vegetable fiber, chiefly on account of having to be applied to the fiber from a strong alkaline bath, a condition unfavorable to the dyeing of animal fiber. They are used to a limited extent for dyeing silk light shades by using glue or glucose as a protectoid in the dye bath. They produce brilliant shades on saponified acetate rayon. They are dissolved, usually with equal parts of sodium sulfide and a small quantity of soda ash at boil. This reduces the dyestuff to a "Leuco Base" and may be entirely different in shade from the original. Cotton or viscose rayon are dyed in this bath at 200° F. with addition of 5 to 50% salt, based on weight of goods for 1 to 2 hours. Squeezed and allowed to oxidize in the air to reach the true shade, then washed with hot water, soaped, washed with hot water, then cold water, and dried. Increased fastness to light and cross-dyeing may be obtained by after-treatment with 2 to 3% chrome; 2 to 3% acetic acid; 2 to 3% copper sulfate at 180° F. for 20 to 30 minutes, then rinsed well and dried.

Owing to being dyed in a concentrated sulfide bath they must be kept from coming in contact with any brass or copper, as this will materially affect the shade. Generally the dyeing machines for sulfur colors are either iron or wood. The sulfur colors find their greatest use in dyeing of cotton raw stock or warp dyeing where the warps go into goods to be cross-dyed or to be fast to washing, that is, for ginghams, etc. For cotton yarns for every use but the fast bleaching trade. For piece goods such as khaki, shirting, drills, ducks, and canvas, auto covers, tops, rain coatings, corduroys and velveteens. For hosiery to produce tans, browns and blacks. Sulfur colors do not produce as bright shades as the direct or diazo cotton colors, but are much cheaper.

Mordant Colors

6. Mordant Colors. The true metallic mordant colors cannot be permanently fixed upon cotton, wool and silk or in fact upon any textile fabrics, except in conjunction with metal. As a rule the metals are fixed as insoluble oxide or hydroxides previous to application of dyestuffs. The reaction takes place between dyestuff and mordant, the hydrogen atoms of the hydroxyl or carboxyl groups being replaced by the metal of the mordant.

There are four classes of Coal Tar mordant dyes:
(a) Anthracene derivatives.
(b) Naphthalene derivatives.
(c) Pyrogallol derivatives.
(d) Nitrose derivatives.

The anthracene derivatives are by far the most important group. This group includes alizarines and its derivatives. Alizarine is produced from oxidation of anthracene, the resulting compound, Anthraquinone, is then sulfonated with concentrated sulfuric acid and resulting sulfonate fused with caustic soda, resulting in formation of alizarine. Alizarine like many of the metallic mordant colors, is polygenetic, and gives different color lakes with different metals.

Red with Aluminium Mordant.
Orange Red with Tin Mordant.
Wine with Chrome Mordant.
Purplish Blacks with Iron Mordant.
Yellowish Brown with Copper Mordant.
Reddish Brown with Zinc Mordant.

(b) The most important color of the naphthalene derivatives is Alizarine Black.

(c) Pyrogallol derivatives are of very little importance, and few in number.

(d) Nitroso coloring matters are produced by action of nitrous acid upon various phenols, and contain the nitroso group.

The mordant colors are largely used in wool dyeing, when it is desired to produce very fast colors. The mordant may be applied (1) previous to dyeing; (2) at the same time of dyeing; (3) after dyeing.

The first method is of most importance.

Large amount of cotton is printed by the steam printing process using mordant colors. They are very fast to light, washing, soaping, alkali, acids and perspiration.

Mordant Acid Colors

7. Mordant Acid Colors are intermediate in character between acid and mordant colors. They resemble acid colors in that they may be dyed directly upon wool in an acid bath and at the same time resemble the mordant colors in that they may be dyed upon metallic mordants. They may be dyed with the mordant in the dye bath. Chromate Colors are an example of this type. They are universally used today on men's and women's wear, having replaced the old mordant colors to a large extent because of their ease of application. By proper choice, on worsted with silk effects woven into the pieces, we can dye the worsted with this class of colors, and leave the silk effects unstained. They possess excellent fastness to light, acids washing, perspiration, spotting, etc.

Insoluble Azo Colors

8. Insoluble Azo or Ingrain Colors, as the name implies, are a group of insoluble colors of the Azo type, and are produced directly on the fiber. Para-Nitra-Aniline Red is of the old type. Naphthol Colors are the new type, and this group of colors replaced the old Turkey Red. They possess excellent fastness to washing, light, and in some cases, bleaching. They produce, by the proper coupling with the various bases on the fiber, shades ranging from yellow to deep orange, reds, blues and blacks. A green has recently come out which is an addition to this line of colors. So far it has not been particularly successful. The Rapid Fast Dye and Rapidogens are new types which have found favorable use both in dyeing and printing.

Vat Colors

9. Natural Indigo was the first vat dyestuff and obtained today by the synthetic process from coal tar. It is, however, the same as that formerly prepared from the plant; manufactured cheaper, purer, and more uniform in color.

Vat colors have been used extensively for dyeing both cotton and wool, but less today on wool than in the past as they have been replaced to a large extent by the alizarines and anthracene blues and mordant acid colors.

Indanthrene is the fastest and most important group of the vat colors. Thio-Indigo, Helindones, Algols and Hydrons of course find their place in the trade.

The Indigosols and Soledons are soluble vat colors, and are developed after dyeing in an oxidizing bath. They are used on loose wool tops, woolen piece goods, printing cotton, rayon, etc., producing excellent fast shades to light, washing, milling and salt water. Reduction vat colors are alll dissolved, or better, reduced in an alkaline hydro-sulfite bath known as hydrosulfite vat, and dyed at various temperatures, some cold, some of the colors at 120° F., some at 140° F., and some at 180° F., depending upon their particular properties and manufacture. They possess excellent fastness as a group to washing, soaping, kier-boiling, and like all other groups, individual colors among the groups possess excellent fastness to light and bleaching. It might be stated here that the vat colors have been looked upon as a standard of fastness. However, today we have some direct colors of recent manufacture which excel a number of the vat colors in fastness to light, but, of course, do not equal their value in washing. They are used principally in printing of cotton goods, in the dyeing of shirt goods or any goods where extreme washing or laundering is likely to take place.

Aniline Black

10. Aniline Black. In itself, Aniline Black is an insoluble pigment of an unknown composition, produced by oxidation of Aniline. Probably a greater number of different methods have been tried for fixing this black pigment upon textile fibers than any other dyestuff or class of dyestuff.

When aniline is oxidized three consecutive products are formed:

(a) Emeraldine, a greenish color salt, insoluble in water.

(b) Nigraniline formed by oxidation of Emeraldine.

(c) Aniline Black proper or ungreenable black, as it is sometimes called, which is formed by the still further oxidation of Nigraniline.

Up to about ten years ago Aniline Black had been used for forty or more years as the fastest cotton black on hosiery, etc. During recent years the sulfur blacks and developed blacks have replaced Aniline Black to a great extent. However, Aniline Black is used largely on calico printing today.

In general, there are two methods of applying Aniline Black:

(1) The oxidation method.
(2) The single bath method.

(1) *Oxidation Method.* This consists in padding the material with a solution containing an aniline salt usually the hydrochloride; some oxidizing agent, usually potassium or sodium chlorate and certain metallic compounds, such as copper sulfide and vanadium salts which act as carriers of oxygen for the production of Aniline Black. Hundreds of recipes have been used and scarcely two dyers can be found using the same recipes. We will, therefore, only attempt to give general amounts in preparation of various baths:

Padding liquor .....100 parts
Aniline salt (hydrochloride).....8 to 12 parts
Copper sulphide .....3½ to 4½ parts
Thickener enough to hold copper sulphide in suspension
Water enough to make 100 parts

The material is padded, dried in the air, passed through a steam chamber, if cloth, or as is usually the case, with

hosiery, aged in oxidizing chamber in the presence of air. The ageing is followed by a treatment with potassium or sodium bichromate solution which carries the oxidation still further.

Aniline Black is extremely fast to light, bleaching and washing, but it is a long process and extensive equipment is necessary.

Acetyl Cellulose Colors

11. Acetyl Cellulose Colors. For many years artificial silk fibers (rayons) have been made, which resemble the appearance of silk, but which are all chemically quite different and possess different dyeing properties. All of the older varieties of rayon are derived from cellulose of some kind and consequently all possess dyeing qualities more nearly analogous to that of the cotton fiber than that of the silk fiber, viz:

(a) Chardonette or Nitro-rayon.
(b) Viscose rayon.
(c) Cuprammonium rayon.

The newest form of rayon is that made from cellulose acetate. Celanese, Seraceta, Rhodiaseta, Lustron, Chacelon, Sombraceta and Acele are some of the trade names. This particular kind of rayon possesses dyeing properties which are totally different from those of any other rayon, or in fact any other fiber. When first discovered, we found only a few colors that had any affinity for this fiber, and those were principally among the basic colors and mordant acid colors. Owing to the poor fastness of the basic colors it was necessary to begin research to discover colors suitable for this fiber to meet the fastness requirement. It was, therefore, anticipated that if the hydrolysis of a suitable dyestuff containing an omega-sulphonic acid group were effected in the dye-bath in the presence of acetate rayon, the latter would be dyed by the insoluble dyestuff base as it was liberated. This preliminary success led to the preparation of a new line of dyestuffs introduced by the British Dyestuff Corporation in England, called 'Ionamine,' some of which dye direct, and others, especially the blues and blacks, are diazotized and developed with beta-oxy-naphthoic acid on the fiber after dyeing. They are dyed at 180° F. from a weak soap bath, rinsed and dried; if development is necessary, they are entered into a fresh bath of 3% nitrite of soda and 9% hydrochloric acid for one-half hour, cold, washed well and entered into a bath made up of 2% beta-oxy-naphthoic acid dissolved with ½% its weight of soda ash, heated to 140° F., slightly acidified with acetic acid for one-half hour, then rinsed, soaped and dried. After the 'Ionamine' a demand then came for faster to light than the 'Ionamine' class, which resulted in the discovery of the Duranol class. Members of this class are derivatives of anthraquinone and possess similar fastness to light, as vat colors, though not so fast to washing and perspiration. It will thus be seen that the dyeing of cellulose acetate rayon presents a very grave and difficult problem, as none of the ordinary methods of dyeing, or the properties of dyestuff which one has learned by the study of other fibers, help one very materially. Other companies have followed in their manufacture of acetate rayon colors, and we have a large variety, but they are all of the above two classes. The 'Ionamines,' when developed with beta-oxy-naphthoic acid are the fastest to date to pressing, dry cleaning, perspiration, etc.

Acetate rayon has distinct advantages over other rayons.

(a) Higher luster.
(b) Good tensile strength, which it retains to a greater extent than the other rayons when wet.
(c) High elasticity, especially in case of Celanese.
(d) A soft, full, silky feel in the fabric.
(e) Extremely high resistance to micro-biological injury, such as mildew, mold and bacteria.
(f) A high thermal and electrical insulating value.
(g) Low inflammability.
(h) Low specific gravity.

In conclusion, each and every fiber has its individual dyeing problems.

Teaching of Color

To facilitate the teaching of color and its application in producing fabrics of utility and beauty, every student in the Textile School of North Carolina State College is tested for his ability to distinguish colors by the Ishihari system which consists of a series of color plates designed by Dr. Shinohu Ishihari, a professor in the Medical Department of the Imperial University of Tokyo.

Five editions of these color plates have been issued and they are now widely used to test the sight of railway employees, candidates for the Navy, and other places where ability to distinguish colors quickly and accurately is of prime importance.

Appointed Textile Director

Kenneth Remington has been appointed director of the Cotton Division of The Traphagen Commercial Textile Studio, 1680 Broadway, according to an announcement made by Ethel Traphagen.

Mr. Remington, who is connected with Mole and Zenke, is regarded as a printing and weaving expert and has been in the field of practical textile work for the past 18 years. He is well known to the trade as an authority on art training and the various branches of scientific textile photography. Mr. Remington will incorporate the results of his study of the relationship of correct design to effective merchandising into his courses at the Traphagen Studio, and will supervise art work, technical details and styling of the designs produced for cotton fabrics.

Rayon Dyeing and Finishing-12

(Continued from page 482, July 31 issue)

By **B. L. HATHORNE**
Consulting Textile Chemist

CHAPTER VII—DYEING AND FINISHING OF RAYON-CONTAINING HOSIERY

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Discussion of Greige Goods

Hosiery dyeing is undoubtedly the most difficult and exacting branch of the dyeing industry. This is true not only because of the close matching that must be done with respect to shade, but also because of the various combinations of fibers that are encountered in each dye-house; that must be dyed into solid shades and into cross-dye effects and that must be uniform from batch to batch.

The tight knit and pocket-like shape of the heel and toe, places an added burden on the hosiery dyer, as he is limited to the use of dyestuffs and methods that will cause tightly knit heels and toes to dye level. Many dyestuffs that give excellent satisfaction in other branches of the dyeing industry are absolutely unsatisfactory for the hosiery dyer due to the fact that they will not properly penetrate the heel and toe of the hosiery.

Still another factor that complicates the situation in many instances is the unfortunate fact that many hosiery dyers are forced to contend with hard water conditions:—the water being so poor in certain instances that soap cannot be used in the scouring bath due to the tremendous quantity of lime and magnesium salts present.

The following list, while not at all complete, includes the fiber combinations most commonly encountered by the hosiery dyer of today:

(1) Regenerated cellulose rayon combined with cotton.
(2) Regenerated cellulose rayon combined with mercerized cotton.
(3) Regenerated cellulose rayon combined with untreated cotton and mercerized cotton.
(4) Regenerated cellulose rayon combined with real silk and mercerized cotton.
(5) Regenerated cellulose rayon combined with acetate rayon and mercerized cotton.
(6) Regenerated cellulose rayon combined with real silk, acetate rayon and mercerized cotton.
(7) Regenerated cellulose rayon combined with wool.
(8) Regenerated cellulose rayon combined with cotton and wool.
(9) Most of the above fiber combinations in which resist dye fibers are present, for example, regenerated cellulose plaited over strips of resist dye cotton and containing a clock of resist dye cotton of rayon.
(10) Various specialty fiber combinations.

It might be assumed from the above list that regenerated cellulose rayon represents only one variable factor in each instance. Nothing could be further from the truth. Each brand of rayon, and indeed rayon produced by the same manufacturer in different plants, has a different dye affinity. Ordinarily minor variations in dye affinity between yarns produced by different manufacturers does not cause the dyer an undue amount of trouble, as it is only necessary for him to make certain additions or changes in his dye formula to care for this difference. With the hosiery dyer, however, minor variations in dye affinity are tremendously important as they upset nicely balanced formula and seriously interfere with the production of satisfactory union effects.

As is the case in the production of circular knit rayon fabric, it has been found necessary to apply a very considerable amount of oil to rayon before the knitting operation in order to produce satisfactory merchandise without excessive waste. At the present time, practically all hosiery containing rayon reaches the dyer containing between two and ten per cent of oil based on the weight of rayon present.

All that has been said regarding rayon lubricating oils and troubles caused by the same in Chapter VI relating to circular knit rayon fabrics, applies equally well to rayon and rayon-containing hosiery.

Regardless of how carefully the knitting room is run, and regardless of how carefully the machines are kept in good repair, a certain amount of hose are bound to reach the dye-house containing misplaits. When cross-dye

effects are required, nothing can be done about misplaited hose—they must become seconds. However, when solid shades are wanted, the production of practically perfect matches by the dyer often enables hose containing small misplaiting flaws to be accepted as firsts. The necessity of dyeing different fibers to such a close match that a misplait can pass inspection, develops the matching ability of hosiery dyers to such an extent, that as a group they have become the most efficient color matchers in the industry.

It sometimes happens that due to economic reasons, or as a temporary expedient in order to utilize idle stocks of yarns, hose are produced containing fiber combinations that are absolutely improper from a dyeing viewpoint. Hosiery dyers make large quantities of such hose presentable enough to become commercial, although from a theoretical viewpoint, it often appears impossible to get the desired result.

The greatest single cause of grief for the hosiery dyer is the constant reoccurrence of batches of hosiery containing mixed stock. By this we mean a single dye lot containing mixed yarns. For example, the rayon in one-half of the lot may have been bought from a different rayon manufacturer than the rayon in the other one-half of the lot. Such batches cause hosiery dyers considerable trouble, as the difference does not show up until after the start of the dyeing operation.

The usual procedure in cases of this sort is to continue with the dyeing until the desired match is produced on one part of the batch, the other part being allowed to take whatever color it will. After dyeing the hose must be sorted and the ones that did not match must be stripped and redyed to the desired shade.

Trouble from mixed stock is particularly annoying to the dyer, as it can be completely eliminated by proper supervision in the knitting and seaming departments.

Description of Hosiery Dyeing and Finishing Equipment

Most hosiery is today dyed in the rotary type of hosiery dyeing machines. These machines consist essentially of four parts:—

(1) A perforated cylinder, longitudinally divided into compartments capable of being revolved on its horizontal axis.

(2) A stationary hollow cylinder surrounding the revolvable cylinder. The stationary cylinder is water-tight and acts as a container for the dye liquor.

(3) A motor and reversing mechanism for the rotary cylinder.

(4) Heating device (live steam).

The older style of rotary machines were made entirely of wood, and many of these are still in service today. The modern machines are made entirely of Monel metal, and are far superior in every way. The new machines are much more gentle in their action on the goods. Another decided asset is the ease of changing from shade to shade on a single machine. Dark shades can be followed with light shades in the same machine without the necessity of a preliminary stripping action to cleanse the kettle.

Some types of hosiery are most advantageously dyed in the paddle type of hosiery dyeing machine. A paddle machine is what the name implies, a dye tub with a large revolving paddle. The paddle is set on the top of the tub in the center in such a way that approximately one-third is dipped under water when the machine is in operation. The tub itself is so designed that the general contour is somewhat similar to the lower half of the paddle itself. That is, the sides are straight, but the ends curve in towards the center of the tub in a smooth arc that is almost one-quarter of a cylinder. This shape allows the dye liquor, stockings included, to revolve at a rather rapid rate of speed during the entire dyeing operation. The paddle machine is more violent in its action than is the rotary machine. This makes it especially adaptable for goods that are difficult to penetrate.

A hosiery dye-house must be equipped with one or more of the usual centrifugal extractors.

Due to the number of sizes that have to be handled at one time, and also due to the tendency of ladies' hose to tangle during the dyeing operation if allowed too much freedom of movement, hosiery is usually placed in net bags before the dyeing operation. These bags are manufactured from a high grade strong cotton twine made with a very open mesh in order that liquor may pass freely within the bag. After being filled with hosiery, the bags are closed by means of heavy brass or Monel safety pins, or are tied with a cotton cord.

After the dyeing and extracting operations, it is necessary that the hosiery be dried while held in an expanded condition, in order that it shall be put in a presentable form for sale. For this purpose, hosiery "boards" or forms are used. Practically all the "boards" in use today are the modern hollow metal forms. These forms are divided into two classes:—

(1) Hot Water Boards:—
As the name implies, hot water forms are heated by the circulation of hot water within the hollow form. These forms are used for the very sheer hose, for which a uniform temperature of 140° F. to 180° F. is required.

(2) Steam Boards:—
For the boarding of heavy hosiery, steam boards are customarily used because the higher temperature of these boards hastens the drying operation termendously. As the name implies, these boards are heated by means of live steam.

(To be continued)

TECHNICAL NOTES

(Continued from page 490)

In the perfume industry, indeed, much attention has been given to such compounds, since, by way of example, the esters of hexyl, heptyl, octyl, nonyl, and decyl alcohols are valuable in the synthesis of perfumes, and the corresponding alcohols have therefore been carefully studied for possible methods of profitable synthesis. But the perfume industry, on account of the peculiar conditions under which it works, has not been frightened away from such a field by the question of (at first) high cost.

It has long been known, as a matter of theory, that a carboxylic acid can be reduced back to the related alcohol, and the reaction has often been carried out in research laboratories on the very small scale, in the process of solving some problem; but the reaction has remained decidedly a merely laboratory method, until Schrauth's method was developed — a successful large-scale catalytic method. Such alcohols as the above-mentioned are now comparatively easy of access, as well as those even higher up in the series; and, consequently, have been carefully studied as to the possibility of usefulness in textile work.

In the higher part of the alcohol series, certain properties come to light, which promise much help in various textile operations. As their molecular weight increases, the melting-point, boiling-point, density, and hardness increases, while the solubility in water decreases. The series exhibits every possible gradation of physical consistency, from mobile liquids, through thick oils, to wax-like solids of greater or lesser hardness, and all transitional forms are present in the series. One property in particular is of fascinating importance; as a group, these alcohols possess a great dispersive power, and the resulting disperse-phase emulsions are of distinctly colloidal nature.

In the series, up to a certain point, as the solubility in water disappears, the higher alcohols are converted, by Turkey red oil or soaps, into clear aqueous solutions. But, beginning with decyl alcohol, as one advances in the series, another phenomenon becomes evident. They dissolve to a clear solution in Turkey red oil, but, when this solution is diluted, not a clear solution, but an emulsion, is formed, in the case of dodecyl (lauryl) alcohol, the emulsion is snowy white, so pronounced is its degree of dispersion. It is therefore possible, by selection, to prepare an emulsion of almost any degree of dispersion. Lactic acid esters or glycol ethers, or other water-soluble solvents, can be used in place of Turkey red oil or soap solutions.

To turn to a definite example: a German firm (the Deutsche Hydrierenwerken A.-G.) is now manufacturing a preparation called Lanette Wax, a mixture of palmityl and stearyl alcohols, from the catalytic reduction of the fatty acids of tallow. Its melting-point is about 50° C., its sp. gr. fused at about 50° C. is about 0.81, and it contains no acids or unsaponified material, etc. It is insoluble in water, soluble in ethyl alcohol, very soluble in ether, benzene, etc. With the common emulsifying agents, as soaps, Turkey red oil, aromatic sulfonic acids, etc., it forms homogeneous mixtures, easily emulsifiable in water, and these emulsions will stabilize emulsions of other substances, as paraffine, ceresine, stearine, fats, oils, etc. Modifications of this Lanette Wax are also manufactured, with slightly different, but equally desirable properties. Also, the palmitic ester of the simple product (a synthetic stearyl-palmityl palmitate) is manufactured as a synthetic spermaceti, of great value in the textile, cosmetic, soap, and leather industries. This product is really a synthetic wax.

It is a question, however, whether the product can be used as a true substitute for Carnauba wax, for example, in all cases; and this question has not yet been solved; whether it is a complete and perfect substitute, or whether it can be used only as a partial substitute, in mixture with the natural wax. The relative price of each may prove to be the deciding factor.

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